SFWMD Draft Response to Peer Review Comments of Donald M. Kent, Ph.D. for the July 2002 Draft Loxahatchee River MFL Technical Documents

Dr. Kent made the following comments concerning the methods, approach, and documentation of the proposed MFL:

Page 2, 3rd Paragraph: *The 15 July 2002 Draft MFL document substantially improves upon the 22 May 2001 Draft. However, my interpretation of the findings suggests a different minimum flow at the Lainhart Dam. The final minimum flow criteria, regardless of its value, should be related to other flows to the Northwest Fork and to other parts of the Loxahatchee River and Estuary.*

Page 3, 1st Paragraph: *The District has done a good job presenting a defensible scientific basis for setting minimum flow criteria for the Wild and Scenic River part of the Northwest Fork of the Loxahatchee River and Estuary. The MFL document describes the River and Estuary in sufficient detail, including climate, physical features, hydrology, biological and water resources, and nearby land uses. In addition, the MFL document and appendices describe in adequate detail the methods and information used to develop the MFL criteria. For the most part, the approaches and concepts described in the MFL document are scientifically sound and based upon best available information…The MFL document describes and discusses in sufficient detail historic, current and anticipated flows over the Lainhart Dam. Also, the document describes the relationship of Lainhart Dam flow to Northwest Fork salinity both empirically and as modeled by the hydrodynamic/salinity model. Collectively, this information supports a reasoned assessment of the Lainhart Dam flow necessary to sustain desired vegetation communities downstream to Cypress Creek. However, beginning with Cypress Creek, nearly 50 percent of the flow to the Northwest Fork comes from tributaries. Therefore, an assessment based upon flow over Lainhart Dam must ensure that absolute and relative flow from other sources is maintained. Alternatively, the assessment must incorporate anticipated changes in flow from these other sources…Salinity is convincingly the primary factor determining the location and condition of the floodplain swamp and mangrove communities.*

Page 4, 3rd Paragraph: *Results of soil salinity transects are a welcome addition to the MFL document. Soil salinity may be as important, if not more important, than water salinity in determining the location and condition of the stream swamp community.*

Page 4, 4th Paragraph: *The vegetation survey results and the hydrodynamic/salinity model afforded a tremendous opportunity to evaluate the relationship between vegetation community and river salinity. As the District recognizes, vegetation could be responding to certain salinity levels or salinity ranges, the duration of a particular salinity event, the frequency of a particular salinity event, or other factors. SAVELOX manages these potentially confounding variables by creating a new variable D_s/D_b (duration of exposure/time between exposures) as a surrogate for long-term salinity conditions. This is an admirable attempt to integrate the various salinity factors. Our understanding of the relationship between vegetation community and salinity may also benefit from an examination the relationship between vegetation community and individual salinity factors, and combinations of salinity factors. If this has not already been accomplished, the District might consider the use of step-wise regression analysis.*

Page 5, 5th Paragraph: *The District has expended considerable effort in investigating and evaluating technical approaches for setting the criteria. No other technical approaches are recommended, other than those previously noted.*

Page 6, 3rd Paragraph: *The VEC approach has merit, and can be a valuable tool for management decision-making when the value of the selected ecosystem component is clearly established, and the relationship between the selected ecosystem component and other ecosystem components is clearly defined.*

The VEC approach for the Loxahatchee River and Estuary MFL was improved in this draft by replacing cypress with six stream swamp tree species. In this manner, the relationship between the VEC and the stream swamp community is more clearly defined.

Page 7, 2nd Paragraph: *The literature review is reasonably complete for the intended purpose, if the purpose is solely the protection of the stream swamp community in the upper reaches of the Northwest Fork.*

Page 7, 3rd Paragraph: *For the most part, the statistical analyses of historical flow, salinity and vegetation data are appropriate. The District's efforts indicate due diligence, and a willingness to be innovative.*

Page 7, 5th Paragraph: *The methods used to estimate the movement and location of the freshwater-saltwater interface under different flow conditions are appropriate and reasonable for estimating salinity conditions along the Northwest Fork of the Loxahatchee River.*

Page 7, 6th Paragraph: *The methods used to characterize the vegetation community composition and distribution are appropriate and reasonable.*

Page 8, 1st Paragraph: *The two-dimensional hydrodynamic-salinity model is a useful device to describe the effect of various freshwater flow regimes for the river and estuary.*

Page 8, 3rd Paragraph: *Defining specific duration values for the minimum flow criteria is a difficult task. The approach taken by the District is innovative and illustrates a determination to make the best decision possible. Undoubtedly, the duration estimates derived from the analyses are educated guesses. Nevertheless, the criteria are better served with their inclusion than without.*

Page 8, 4th Paragraph: *The District has demonstrated considerable diligence in obtaining and analyzing hydrological, salinity and vegetation data for the Northwest Fork of the Loxahatchee River. The hydrodynamic/salinity model and the SAVELOX model are appropriate and reasonable approaches to defining ecosystem component relationships and deriving minimum flow criteria.*

Dr. Kent expressed the following concerns regarding the Draft document:

Page 3, 2nd Paragraph: *The MFL document describes and discusses in sufficient detail historic, current and anticipated flows over the Lainhart Dam. Also, the document describes the relationship of Lainhart Dam flow to Northwest Fork salinity both empirically and as modeled by the hydrodynamic/salinity model. Collectively, this information supports a reasoned assessment of the Lainhart Dam flow necessary to sustain desired vegetation communities downstream to Cypress Creek.* ***However, beginning with Cypress Creek, nearly 50 percent of the flow to the Northwest Fork comes from tributaries. Therefore, an assessment based upon flow over Lainhart Dam must ensure that absolute and relative flow from other sources is maintained. Alternatively, the assessment must incorporate anticipated changes in flow from these other sources.***

- **District Staff's Response**: The flow analysis used to develop the MFL criteria were based upon best available information. Flows from the other tributaries were included in the analysis, however measured flows were not available from Cypress Creek or Hobe Grove Ditch after 1991. The percent of flow contributed by the Lainhart Dam to the NW Fork in the model is 44%. This compares with field measurements that show the Lainhart Dam to provide 45% of the flow for the 1980-81 drought dry season, 46% from the 1980-81 drought wet season, 40% from the 1989-90 drought dry season, and 56% from the 1989-90 drought wet season. Based on these data, the flow ratio of 44% provided in the model appears to be a reasonable ratio for estimating the flow contribution provided by the Lainhart Dam and other tributaries during dry periods, the period of time when a minimum flow would be of interest.

The District has recently completed a contract with the USGS to update and improve the current flow/salinity monitoring program within the watershed. Additional flow gages and salinity monitoring instruments are being installed in Cypress Creek and Hobe Grove Ditch. These additional gages will provide the data needed to more fully understanding the role that these tributary basins play in shaping the river's salinity profile.

Page 3, 3rd Paragraph: *Salinity is convincingly the primary factor determining the location and condition of the floodplain swamp and mangrove communities. However, water quantity may be an important factor in determining the location and condition of stream swamp and cypress within the upper reaches of the Northwest Fork and its tributaries. For example, parts of the middle and upper Northwest Fork and Kitching Creek (Segments 2, 3 and 5 of Figure B-3) have consistently been characterized by freshwater, but the vegetation community has changed from cypress to stream swamp.* ***The MFL document should be explicit about whether the goal is cypress, stream swamp or either. If the goal is cypress, then the effect of changes in flow on freshwater vegetation community location and condition should be evaluated.***

- **District Staff's Response**: The reviewer correctly points out an inconsistency in the information contained in the Figures contained in Appendix B and Table 33 in the main text of the report. This will be corrected. District staff were unable to distinguish between the categories of stream swamp and cypress in the 1940 aerial, so we cannot say there has been change from one freshwater swamp type to another (i.e. stream swamp & cypress swamp). The legends of the above mentioned figures must be changed and the text must be modified to reflect this problem in interpretation.

Page 4, 1st Paragraph: *Legal and policy decisions have limited MFL criteria development to the Northwest Fork of the Loxahatchee River and Estuary.* ***Nevertheless, potential impacts (positive and negative) to other parts of the system should be evaluated and the results described.*** *For example, the Estuary provides numerous resource functions including habitat to protected species (e.g., Johnson's seagrass, Halophila johnsonii; West Indian manatee, Trichechus manatus latirostris). The District recognizes that a "… viable estuarine ecosystem requires a proper balance of freshwater inflow…"(Chapter 3), but the document fails to discuss if this balance will be achieved and by what means the balance will be evaluated.*

- **District Staff's Response**: A section needs to be added to the Chapter 5 (results) that explains the effects of the proposed MFL on conditions and resources in the estuary.

  An effort was made to characterize significant resources that exist in the estuarine portion of the Loxahatchee system (Chapter 2 pages 22-31). These included primarily mangrove swamp communities, other saltwater marsh vegetation, seagrasses and marine algae, fishes, macroinvertebrates and manatees. Our present (very limited) understanding of the relationships between these system components and freshwater inflows was also described. The Loxahatchee estuary covers the entire range from a primarily marine environment near the inlet and into the central embayment to a completely freshwater environment in the upper reaches of he Northwest Fork.

  Physical features of the estuary are summarized on pages 17-21. The North Fork portion of the estuary is very small in extent and has very limited resources due to several factors. The lower reaches have been extensively bulkheaded and filled, effectively eliminating important shoreline habitat. In addition, large areas of the bottom consist of soft mud or ooze that is not conducive to supporting estuarine benthic communities. The upper reaches within Jonathon Dickinson State Park in this section of the North Fork Loxahatchee River have steep shorelines that do not support significant amounts of marsh or swamp shoreline vegetation.

  The Southwest Fork is very small in size and has limited resources, probably due to the relatively frequent large discharges of freshwater from S-46 that result in scouring of the substrate and rapid and extreme salinity changes.

  None of the resources or issues in the North Fork or Southwest Fork of the estuary was considered to have a significant function that would be impacted by low flow conditions. In contrast, the resources of the Northwest Fork, Central Embayment and adjacent coastal waters are primarily

sensitive to high flow events. When large discharges of several thousand cfs occur through the S-46 structure into the Southwest Fork, the entire system can become freshwater, which has significant adverse effects on marine life, especially seagrasses and benthic macroinvertebrates, and results in displacement and loss of habitat for fishes that prefer the more saline conditions.

It appears to us that low flow conditions in the Northwest Fork do not have any significant adverse effects on the estuary and may in fact be beneficial rather than harmful to these resources. Under very low flow conditions (see Appendix F, Figure F-4), most of the estuary becomes a marine system (30-35 ppt salinities). If these low flow/high salinity conditions persist for several weeks or months, seagrass communities may tend to expand upstream, providing more habitat and food for marine and estuarine fishes and invertebrates, additional stabilization of soft mud bottom communities and provide additional food for manatees. There may be some mortality occurring in oyster communities at the upper end of the Northwest Fork and some associated recruitment occurring further upstream.

The upper reaches of the Northwest Fork still contain extensive areas of habitat suitable for oysters, as well as oligohaline and freshwater habitat. Extreme fluctuations in salinity, associated with periodic low flow events, are not conducive to the development of extensive oyster communities. Oysters are very beneficial to coastal estuaries such as the Loxahatchee River because they tend to stabilize bottom sediments, provide filtration of suspended materials from the water column and provide an extensive surface area and substrate for colonization of other organisms.

The importance of a stable and extensive oligohaline zone to the health of the estuary has been well studied and documented in a nearby coastal system, the St. Lucie Estuary, located just a few miles north of the Loxahatchee River. Unfortunately, we do not have the same type of extensive data for the Loxahatchee River, although the limited studies we have suggest that the species composition of fishes and macroinvetebrates in these two systems are similar. The Loxahatchee River has more extensive and healthier seagrass and oyster communities, as a total proportion of the area of the estuary, than are found in the St. Lucie Estuary.

In the St. Lucie Estuary we were able to identify the oligohaline zone as the resource that was of primary concern in this system, that this resource would be significantly impacted by reduction of freshwater flow, and therefore needed to be protected by establishment of a MFL. We therefore proceeded to quantify the amount of oligohaline habitat that was lost to the estuary during periods of low flow and identify a critical point in the flow regime when the amount of freshwater entering the estuary from tributary flow was less than the amount of water that was being lost to the system due to evaporation.

By contrast, in the Loxahatchee River system, we have identified the freshwater swamp community in the river floodplain as the primary resource that needs to be protected by establishment of a MFL and (have largely assumed) that the estuary portion of the system will benefit from this improved flow regime by receiving a more stable flow regime that will provide more stable habitat conditions.

The effect of implementing the proposed MFL on this system is anticipated to help further improve conditions in the estuary by providing for a more extensive and stable oligohaline zone (less than 5 ppt salinity) upstream in the river between mile marker 9.2 and 8.5 or so, than occurs at present. Conditions that are more conducive to the growth of oysters on mangrove roots and the formation of oyster reefs or bars (15-25 ppt salinity) are expected to occur in the vicinity of mile marker 6 along the river. At the same time, these flows are not expected to adversely affect the marine communities that live in the central embayment, especially the Johnson's' seagrass community that exists near the railroad bridge.

Page 4, 2nd Paragraph: ***The MFL document may give undue weight to 2-ppt salinity. Both the hydrodynamic/salinity model and the SAVELOX model appear to directly equate 2 ppt salinity to salt water, and to indirectly suggest that 2 ppt is threshold for the stream swamp****. The former is a useful mechanism for estimating the relative position of fresh water and salt water. However, there is no basis*

presented for a relationship between 2 ppt and vegetation type. In fact, model results suggest that a mean salinity of 0.15 ppt is related to the occurrence of a healthy stream swamp community. Table 25 (p. 101) also suggests that a healthy stream swamp community requires a mean salinity of < 1 ppt.

- **District Staff's Response**: The 2-ppt salinity value comes from a review of historical salinity trends (as simulated by the model) experienced at river mile 10.2. The point we were trying to convey is that within this remaining "healthy" freshwater community, 2 ppt was near the maximum salinity value recorded over the 30-year period. Given this salinity history, this portion of the river still appears to support a healthy freshwater vegetation community even though salinity events of this magnitude (up to 2 ppt) occur approximately once ever 6 years for an average of 20 days duration. We used this data to characterize the upper limit at which these communities appear to tolerate using best available information. We did not intend to imply that the 2 ppt is any kind of scientifically derived threshold value that characterizes saltwater conditions, other than that is what appears to have happened at these sites over time based on the modeled salinity history.

  It should also be noted that the 2-ppt salinity concentration represented in the model is the daily mean. In other words, salinity could range from 0 to 4 ppt throughout the daily tidal cycle, but the mean salinity would be 2 ppt. A mean daily concentration of 1 ppt would indicate that daily salinity concentrations would vary from 0 to 2 ppt, and is found at the location on the NW Fork where salinity is 0 ppt during low tide and can reach 2 ppt only during high tide. At this site, predominantly freshwater conditions (less than 1-ppt) would occur during the period between high tides. Under these conditions, river channel salinity above 1 ppt would be transient, lasting only a few hours before the next tidal cycle would change the river channel water back to predominantly freshwater conditions. It is felt that with the flushing of salinity between high tides and the predominance of freshwater conditions, significant harm would most likely not occur when mean daily concentrations occasionally were at 1 ppt. For this reason, 2 ppt (the next integer higher) was chosen as a better number to use to define the threshold salinity concentration at which significant harm could occur. Furthermore, the model used to derive these salinities is not sufficiently sensitive to reliably resolve salinity values to 0.1, or even 0.5, whole numbers should be used.

  It is recognized that a healthy stream swamp community requires a mean salinity of < 1ppt (as Dr. Kent described above) and an associated flow to maintain that freshwater state. However, the MFL is concerned with the lowest allowable flow rate, duration and return frequency that would cause significant harm, not the average flow condition at a particular site. At river mile 10.2, salinity did increase above 2 ppt for short durations during extremely dry years. For that reason, it was calculated that a daily mean concentration of 2 ppt (as defined by the model) should not occur for longer than 20 days once every 6 years. This also assumes that freshwater conditions are dominating that site the rest of the time by District's operational policy of delivering 50 cfs to the NW Fork of the river (via G-92 and the Lainhart Dam) when upstream water is available.

Page 4, 3rd Paragraph: *Results of soil salinity transects are a welcome addition to the MFL document. Soil salinity may be as important, if not more important, than water salinity in determining the location and condition of the stream swamp community. However, a comparison of the transect locations with plots of historic and existing vegetation (e.g., Figure B-3) suggest that samples were collected in areas that have not experienced changes in vegetation. Presumably, soils in these areas have not experienced significant variation in salinity.* ***An evaluation of soil salinity affects on vegetation community may be enhanced by samples collected at locations subject to changes in vegetation community and exposure to salt water, and locations with stressed stream swamp communities****. Said samples would help us understand the cumulative effects of salt exposure, and allow the construct of a relationship between soil salinity and stream swamp condition.*

- **District Staff's Response**: Soil transect site #3 was in a location of the river where some changes in the local plant community (stress), due to salinity, were observed. These included the presence of some red mangrove, abundance of pond apple, and the lack of Virginia willow. The semiquantiative survey also showed a reduction in the number of species observed. The field study data from this site

can be found in Appendix C. Unfortunately, the results of the quantitative vegetation survey from this site was not included in the analysis presented in the technical document, since only one bank was surveyed and not both (as with the other sites). It is believed that these changes have occurred since the 1970's (based on aerial photo-interpretation presented in Appendix B). The four soil sampling transects represented a salinity non-impacted site (transect 1), rarely impacted site (transect 2), regularly impacted site (transect 3), and highly impacted site (transect 4) along the NW Fork. This was explained on page G-2 on Appendix G. We can further emphasize this by rewriting and clarifying this description of the sites.

Page 5, 2nd Paragraph: *The proposed MFL criteria is based on a desire to prevent the salinity at RM 9.2 from exceeding 2 ppt for any longer than has occurred within the healthy swamp community (i.e., no more than 20 days duration more often than once every six years). The document then concludes that Table 40 can be used to select a flow over Lainhart Dam of 35 cfs to maintain mean daily salinity below 2 ppt at RM 9.2. However, a flow of 35 ppt in Table 40 corresponds to ≤ 2 ppt for 30 days once every four years, and not a mean salinity of 0.15 ppt and the duration and frequency parameters for RM 10.2 (see above) intended to be mimicked for RM 9.2.*

- **District Staff's Response:** There were some errors in the table and associated text and the table was not formatted or explained adequately. The following is a revised Table 40 and explanation.

Table 40 Various Salinity parameters that can be used to protect the resource

River Mile	Approximate Flows (cfs)* needed to maintain salinity concentrations:				
	Mean = 0.15 ppt	Mean = 0.3 ppt	Salinity ≥ 1ppt Not to exceed 31 days/1.6 yr**	Salinity ≥ 2ppt Not to exceed 22 days/5.9yr	Salinity ≥ 3 ppt Not to exceed 14 days/10yr
10.2	50	**35**	20	10	5
9.7	80	50	**32**	25	15
9.2	100	70	47	**35**	**22**
8.9	140	85	60	42	**27**
8.6	150	120	75	55	42
8.35	200	130	80	65	52

* Flows obtained from Table 37 for a given salinity value at a given station location

** Occurrence frequency and duration were obtained from Table 36: for example for 1ppt salinity at station 10.2 *Ds* = 31 days and *Db* = 576 days or 1.6 years; Likewise at 2-ppt salinity, *Ds* =22 days and *Db*=2157 days or 5.9 years

The intent was to display an array of management criteria that could be used as the basis for "transferring" the hydrologic regime from Mile Marker 10.2 down to various downstream mile markers to RM 8.35. The basis of this table is the Ds and Db values listed in Table 36 and the flow required to maintain a given salinity value as listed in Table 37. Thus if the desired intent is to use a mean salinity concentration of less than 0.15 ppt as the management criterion, it can be seen from the first column in Table 37 that a mean flow of 50 cfs is needed to provide this salinity regime at station 10.2 and a mean flow of 100 cfs is needed to provide this mean salinity at station 9.2. Similarly, if the intent is to use a salinity exposure of 2 ppt as the management criterion then, according to Table 36, such an event occurs only 22 days every six years at station 10.2 and (from Table 37 column 2, bottom row) is associated with a flow of 10 cfs. To transfer a comparable salinity exposure of 2 ppt downstream to river mile 9.2, a flow of 35 cfs (Table 37 column 5, 4th row from the bottom) should be allowed to occur no more often than 22 days every 5.9 years.

Page 5, 3rd Paragraph: *The MFL criteria is also predicated on the belief that vegetation at RM 10.2 is healthy, vegetation at RM 9.2 has suffered significant harm, and that vegetation between these two stations has been harmed (but not significantly). However, the significant harm criteria applied to the vegetation between RM 9.2 and RM 10.2 suggests that much of this area has also suffered significant harm. Three VEC species are missing at RM 9.3 and two VEC species are missing at RM 9.7 (one species is missing at RM 9.9). Also, seedlings for four of the six VEC species are missing from the community between RM 9.2 and RM 10.2. Perhaps the definition of significant harm should be clarified to indicate whether all conditions must be satisfied, or whether failure to satisfy one of the criteria is sufficient to designate significant harm.*

- **District Staff's Response**: Many of these concerns could be addressed by implementing a more comprehensive data collection and sampling program to eliminate some of the sources of variation noted above, such as whether the absence of a particular species at a particular point in the rive was due to sampling limitations or natural variability in distributions rather than the effect of salinity. Loss of any one of the VEC species from the canopy structure, to the extent that it could be reasonably be inferred to be due to salinity stress or toxicity, would arguably be considered a significant impact, in that several years (at least) of stable freshwater conditions would be required in order for it to regrow to the extent that its role in the canopy structure would be restored.

Page 5, 4th Paragraph: *Significant harm for the vegetation community between RM 9.2 and RM 10.2 can be avoided by reproducing salinity conditions at RM 10.2. According to Table 37, a flow of 50 cfs at the Lainhart Dam will produce a mean salinity of 0.14 ppt at RM 10.2. A flow of 100 cfs at the Lainhart Dam will produce a comparable salinity condition at RM 9.2, and by extension at intervening locations. Flows less than 100 cfs will likely eliminate mature individuals or seedlings of the six VEC species, and thus impart significant harm.*

- **District Staff's Response**: Please see our previous response to *Page 4, 2nd Paragraph.*

Page 6, 1st Paragraph: "…***The document has not been reorganized to provide a section on the expected impact of flow modification on the Loxahatchee River and Estuary. Nor does the document provide MFL recommendations for the North Fork, Southwest Fork or the Estuary….*** *the current document addresses the question of whether mangroves continue to encroach on the stream swamp community, inflow data for the entire Estuary, and the inadequacy of information relating cypress condition to salinity. Conversely, the current document fails to address the Panel's comments about anticipated regional growth and development, feasibility of proposed actions, the inadequacy of a linear approach to flow and discharge relationships, and a lag between Lainhart Dam flow data and downstream salinity.*

- **District Staff's Response**: The effects of anticipated regional growth and development on water resources in the region are being addressed through the development of a "MFL Recovery Plan" as required by state law (Ch. 373.042(1) for those water bodies which do not presently meet the proposed MFL. The Northern Palm Beach County Comprehensive Water Management Plan (NPBCCWMP) addressed this issue in considerable detail to define water sources and anticipated uses over the next 20 years and determine projects that are needed to ensure that additional water is provided to the Loxahatchee River to meet and exceed the proposed MFL. Approximately $40 million will be spent over the next 15 years to implement this plan. In addition, the Northern Palm Beach County Component of CERP is presently being modified to consider growth, development, water supply, regional storage and flow restoration needs for the Loxahatchee River and its entire watershed. This program anticipates expenditures about $400 million to build long-term storage facilities and provide connections between the Loxahatchee River and regional water management facilities.

  The regression method used initially to develop relationships between flow and salinity was a non-linear technique (see Appendix D, pages D-1 to D-10), but the Excel spreadsheet application for this purpose was shown to be inadequate. SAS was used to develop an improved non-linear relationship, but this approach also was felt by District staff to have some significant predictive limitations. Lag times of 3, 6 9 and 12 days were incorporated into the SAS analysis in an attempt to improve the results, but did not result in a significant improvement in correlation values (Pages D-11 to D-22). It was felt that neither of these regression approaches was especially useful and provided very limited capability to extrapolate beyond known data sets or incorporate alternative modeling scenarios that might involve modification of flows from the different sources.

  For this reason it was decided to move forward with development and use of the hydrodynamic model as recommended in the initial peer review as a means to quantify flow and salinity relationships for the river.

Page 6, 3rd Paragraph: *The VEC approach has merit, and can be a valuable tool for management decision-making when the value of the selected ecosystem component is clearly established, and the relationship between the selected ecosystem component and other ecosystem components is clearly defined. The VEC approach for the Loxahatchee River and Estuary MFL was improved in this draft by replacing cypress with six stream swamp tree species. In this manner, the relationship between the VEC and the stream swamp community is more clearly defined.* ***However, the use of six stream swamp tree species has not clarified the relationship between the VEC and other Loxahatchee River and Estuary ecosystem components. Of particular concern is the absence of an identifiable relationship with estuary resource functions.***

- **District Staff Response**: The District's approach was to successively establish and build a sequence of inferred relationships 1) between flow and salinity, 2) between flow, salinity, tree distribution and the amount of flow needed to sustain the tree community, 3) between the amount of flow needed to sustain the tree community and the resulting salinity distribution in the estuary (Appendix F), and 4) between known presence and distribution of major species in the estuary and information from field observations and literature concerning likely effects of the resulting salinity conditions on these species.

Page 7, 2nd Paragraph: *The literature review is reasonably complete for the intended purpose, if the purpose is solely the protection of the stream swamp community in the upper reaches of the Northwest Fork.* ***The literature review should be expanded if it is also the purpose of the MFL criteria to protect the Loxahatchee River Estuary.***

- **District Staff's Response**: Comment noted.

Page 8, 2nd Paragraph: *The use of historical hydrological and/or ecological data and findings were used appropriately to determine minimum flow criteria for the Northwest Fork, although the findings are subject to interpretation (see above). Historical hydrological and/or ecological data should be applied to a minimum flow criterion for other parts of the Loxahatchee River and Estuary, especially the latter.*

- **District Staff's Response**: We have some potential capability to expand our look at historical conditions in the estuary. Certainly it would be interesting to examine historical aerial photography of mangroves and saltmarsh communities throughout the estuary (from the inlet up through all three forks) in 1940 and compare it with the distribution of these communities today. We have some historical information (largely anecdotal) on fishing conditions in the river and we have some information on the distribution of oysters, based on associated dredging/removal activities that have occurred during the past fifty years. We also have information concerning seagrass distribution, since this has largely occurred since the inlet was stabilized. The extent of submerged freshwater vegetation in the river or estuary prior to opening of the inlet is unknown.

Summary of Recommendations from Dr. Kent:

1. Establish with minimum flow criteria for other tributaries of the Northwest Fork, and connect these criteria with the minimum flow criteria for the Lainhart Dam.
2. Determine the effect of water quantity on type of freshwater vegetation community in the upper reaches of the Northwest Fork.
3. Evaluate potential impacts to other parts of the Loxahatchee River and Estuary from the minimum flow criteria for the Lainhart Dam.
4. Verify the relationship between 2-ppt salinity and vegetation community or eliminate the assumption from the models.
5. Conduct soil salinity sampling at intervening locations and re-evaluate the relationship between soil salinity and vegetation community.

6. Evaluate the relationship between individual and combined salinity variables and vegetation community.
7. Establish a monitoring program to determine the effectiveness of the final minimum flow criteria.

District Response to each bullet:

1. Data collection efforts are being initiated to address this issue
2. The SaveLox model is being further refined as a possible means to address this issue during the restoration effort.
3. VEC study underway -- salinity relationships have been fairly well established. Need a more comprehensive resource inventory of the estuary.
5. Additional soil salinity monitoring should be considered as part of any additional field research that is being conducted in the floodplain
6. The relationship between individual and combined salinity variables and vegetation communities should be investigated further as part of the restoration effort. Infrequent high flows have not been defined for this effort, but we have defined some threshold impact criteria, mean flows and salinity conditions, and 90% confidence limits for salinity and (by inference) for flows.

Conclusion

Thank you for your helpful comments in this process and pointing out a number of discrepancies in the text, tables and figures contained in the draft document. We agree with your recommendation that we need to add a stand alone section identifying potential impacts to the downstream estuary. Comments on the need to reevaluate our soil salinity sampling methods and locations was also welcome. You have also made us aware of a number of assumptions contained in the report that need to clarified and that, if left unresolved, could ultimately reduce our ability to adequately protect this unique and valuable river. As you may be aware, we are in the process of upgrading hydrodynamic/salinity model to a 3-dimensional version and are collecting extensive synoptic flow and salinity data throughout this basin that we feel will provide the necessary information to address these issues in greater detail.

The MFL proposed in the draft document is intended to be an interim management target based on best available data. We envision the establishment of MFLs for the Loxahatchee River as an iterative process. Projects are already underway to meet the proposed flow of 35 cfs 94% of the time by 2006 and continue beyond that value to provide flows of 65 cfs 99% of the time by 2018. Studies are also underway to examine opportunities to enhance flows from other tributaries – Cypress Creek, Hobe Groves Ditch and Kitching Creek. The SFWMD is initiating studies with FDEP and other agencies to define overall restoration goals for the river that will not only include minimum flow criteria for the river but will also address needs for sustained average flows and periodic high flow periods that are needed to maintain a healthy river and floodplain and downstream estuary. It is anticipated that once the restoration goals for the river have been established in terms of desired flow and ecological conditions, that the MFL criteria will also have to be revised in order to be consistent with protection of the restored ecosystem from significant harm.